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## PATENT SPECIFICATION

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## (54) IMPROVEMENTS IN OR RELATING TO RADIOGRAPHIC APPARATUS

(71) We, GEC MEDICAL EQUIPMENT LIMITED of P.O. Box 2, East Lane, Wembley, Middlesex HA9 7PR, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to radiographic apparatus.

Such apparatus normally includes a control arrangement to enable an operator to select, for an exposure, the values of various variable, e.g. X-ray tube anode current, X-ray tube anode voltage and exposure time, appropriate to the subject to be radiographed and the projection required.

20 It is an object of the present invention to provide a radiographic apparatus incorporating a novel control arrangement.

According to the present invention there is provided a radiographic apparatus incorporating a control arrangement having a number of controls for respectively selecting the values of various variables for an exposure; a storage means; means for entering in said storage means a plurality of different sets of values of said variables selected by said controls; and means for carrying out an exposure with said variables having any chosen one of the stored sets of selected values.

35 It will be appreciated that in use of a radiographic apparatus in accordance with the invention an operator, having once entered a plurality of sets of selected values in the storage means, can carry out an exposure with the variables having any chosen one of the stored sets of selected values without having to operate the controls which select the values of the variables.

45 Normally, each of the stored sets of selected values will be appropriate to a different radiographic examination. For example, one set may be appropriate to a

skull radiograph, another set to a knee radiograph, a third set to a lung radiograph and so on.

Means may be provided for enabling the actual value of a variable used during an exposure to be changed from its stored value. Thus the stored value of a variable e.g. X-ray tube anode voltage may be appropriate to a subject of average size and means is provided for enabling the actual value of that variable used during an exposure to be greater or smaller than the stored value according to whether the subject is above or below average size.

A radiographic apparatus in accordance with the invention is suitably provided with display means whereby prior to carrying out an exposure in accordance with a chosen stored set of selected values at least some of said chosen stored set of selected values are displayed. The display means is suitably arranged also to display the values of at least some of the variables selected by the control means.

A radiographic apparatus in accordance with the invention is preferably arranged to carry out an exposure directly in accordance with the values of the variables selected by said controls as well as in accordance with any chosen one of the stored sets of selected values.

One radiographic apparatus in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a block schematic diagram of the apparatus; and

Figures 2 and 3 show control panels of a control arrangement incorporated in the apparatus.

Referring to Figure 1, the apparatus includes three X-ray tubes 1, 2 and 3 which are adapted for use in different types of radiographic examination. For example, the tube 1 may be adapted for skeletal examinations, the tube 2 for abdominal

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examinations, and the tube 3 for lung examinations

Control of the values of various variables during an exposure with a selected tube is effected by means of control apparatus 4 in dependence on the condition of an electronic switching matrix 5. The condition of the switching matrix 5 is in turn determinable by means of controls on a control panel 6 connected with the switching matrix 5. The control apparatus serves to control high tension generating means 26 supplying the tubes 1, 2 and 3 as well as other equipment associated with the tubes such as a Bucky diaphragm and an automatic exposure control arrangement.

Referring to Figure 2, the control panel 6 has three push buttons 7 for selection of the X-ray tube it is desired to use during an exposure; two rotary control knobs 8 and 9 for selecting the exposure duration and X-ray tube anode voltage respectively; a number of push buttons 10 for selecting X-ray tube anode current, a push button 11 for selecting large or small focal spot of the X-ray tube; a push button 12 for bringing a Bucky diaphragm into use together with further push buttons 13 for selecting a suitable position for the diaphragm from three possible positions; three push buttons 14 for selecting a required field of exposure; two multi-position rotary switches 15 for operating an automatic exposure control arrangement; and a push button 15a for automatic exposure reset.

The control panel 6 is also provided with mains supply 'On' and 'Off' push buttons 16 and an 'expose' push button 17 for initiating an exposure at the tube selected by buttons 7 in accordance with the variable values selected by means of the controls 8 to 15.

The control panel 6 is associated with a display panel 18 for giving a visual display of the values of exposure time, X-ray anode voltage and the product of exposure time and X-ray tube anode current selected by the controls 8, 9 and 10. After exposure these displays show the actual values of these variables which occurred during exposure.

In addition, the display panel carries the legends 'overload', 'wait', X-ray 'on' and 'ready' which light up at appropriate times during operation.

As a further aid, the push buttons are suitably of the kind incorporating a lamp (not shown) which lights when the button is pressed.

As so far described the radiography apparatus is basically of known form and may be constructed in accordance with known principles.

Thus the control apparatus 4 is suitably of the kind comprising a pulse generating arrangement (not shown) which produces a pulse train of which different portions

correspond to different variables. The value of each variable is determined by the number of pulses in the corresponding portion of the pulse train, which in turn is determined by the condition of the electronic switching matrix 5.

In accordance with the invention, the condition of the switching matrix 5, and hence the values of the variables during an exposure is arranged to be determinable by a programme unit 19, as well as by the control panel 6. Thus a radiographic examination may be carried out either with the variables having values as selected by the controls on the control panel 6, or with the variables having values as determined by the programme unit 19.

The programme unit 19 essentially comprises a storage means which is capable of storing a plurality of different conditions of the electronic switching matrix 5 corresponding to a plurality of different sets of values of the exposure variables.

The programme unit 19 is controlled from a keyboard panel 20. Referring to Figure 3, the panel 20 has a push button 21 labelled 'set programme' for setting the programme unit storage means into a 'write' condition and a push button 22 labelled 'press for programme control' for setting the storage means into a 'read' condition. In addition, the panel 20 has a number of push buttons 23 and 24 which are associated with different storage locations in the storage means. For reasons which will become apparent later the buttons 23 are labelled with the names of different subjects for radiographic examination and the buttons 24 are labelled with the names of different projections which may be required.

Operation of the apparatus using the programme unit 19 and its keyboard panel 20 is effected simply by pressing the programme control button 22 on the panel 20, and then those of the buttons 23 and 24 appropriate to the subject and projection required. The switching matrix 5 is thereby operated into a condition determined by data stored in the location of the storage means associated with those of the buttons 23 and 24 which have been pressed, which condition corresponds to a set of values of the exposure variables appropriate to the subject and projection required. An exposure is then carried out in the normal manner by pressing the 'expose' button 17 on the control panel 6.

Return of control of the exposure variables to the control panel 6 is effected by a second operation of the programme control button 22.

Data is entered into the programme unit storage means as follows:

Firstly, by means of the controls 7 to 15 on the panel 6, the operator selects a set of

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values of the exposure variables which he considers are appropriate to a particular subject and projection (for example, an oblique projection of the lungs on tube 3); thereby operating the switching matrix 5 into a corresponding condition. The 'set programme' button 21 on panel 20 is then pressed and the appropriate subject and projection buttons 23 and 24 on the panel 20 are then pressed (e.g. 'lungs' button 23 and 'oblique' button 24). The condition of the switching matrix 5 corresponding to the variable values selected by the controls 7 to 15 is thus entered at a particular storage location in the storage means.

Other sets of values of the exposure variables selected by the operator by means of controls 7 to 15 as being appropriate for other radiographic examinations are entered at other locations in the storage means by operation of others of the buttons 23 and 24.

The operator can thus enter in the storage means a plurality of different sets of values of the exposure variables selected by means of the controls on the panel 6, each set of values being those considered by the operator himself as being appropriate to a different radiographic examination. Subsequently, exposure with the variables having any chosen one of the sets of values stored in the storage means can rapidly be carried out using the panel 20, without the operator having to operate any of the controls on the panel 6 except the 'expose' button 17. It will be appreciated that alteration of any of the sets of values entered in the storage means can be carried out very simply by going through the data entry procedure described above, the previously entered values being cancelled on entry of a new set of values.

In order to take account of different sizes of subject further push buttons 25 are provided on the panel 20. By means of these buttons 25 the actual value of X-ray anode voltage used in an exposure may be made greater or less than the stored value by 2, 5, 10 or 20 kilovolts. Normally the stored value of X-ray anode voltage selected by control 9 on panel 6 will be that appropriate for a subject of average size so that the buttons 25 enable greater or smaller voltages to be used for subjects above or below average size.

To aid operation, when an exposure is made using the panel 20, the displays on the display panel 18 indicate the values of the relevant variables chosen by means of the buttons 23, 24 and 25. Similarly, when an

exposure is made using the panel 20, the push button lamps on the control panel 6 illuminate to indicate chosen variable values.

The push buttons on the panel 20 are also suitably of the kind incorporating a lamp which lights when the button is pressed.

It will be appreciated that in an arrangement in accordance with the invention the storage means is required to be of the non-destructive read out type and is preferably non-volatile. Thus, the storage means is conveniently of the solid state or magnetic core type.

#### WHAT WE CLAIM IS:—

1. A radiographic apparatus incorporating a control arrangement having a number of controls for respectively selecting the values of various variables for an exposure; a storage means; means for entering in said storage means a plurality of different sets of values of said variables selected by said controls; and means for carrying out an exposure with said variables having any chosen one of the stored sets of selected values.

2. A radiographic apparatus according to Claim 1 including means for enabling the actual value of a variable used during an exposure to be changed from its stored value.

3. A radiographic apparatus according to Claim 2 wherein said means for enabling comprises means for enabling the actual value of that variable used during an exposure to be greater or smaller than the stored value.

4. A radiographic apparatus according to Claim 2 or Claim 3 wherein said means for enabling enables the value of the X-ray anode voltage used to be changed.

5. A radiographic apparatus according to any one of the preceding claims including display means whereby prior to carrying out an exposure in accordance with a chosen stored set of selected values at least some of said chosen stored set of selected values are displayed.

6. A radiographic apparatus according to any one of the preceding claims and arranged to carry out an exposure directly in accordance with the values of the variables selected by said controls as well as in accordance with any chosen one of the stored sets of selected values.

7. A radiographic apparatus substantially as hereinbefore described with reference to the accompanying drawings.

For the Applicants,  
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COMPLETE SPECIFICATION

3 SHEETS

*This drawing is a reproduction of  
the Original on a reduced scale  
Sheet 1*

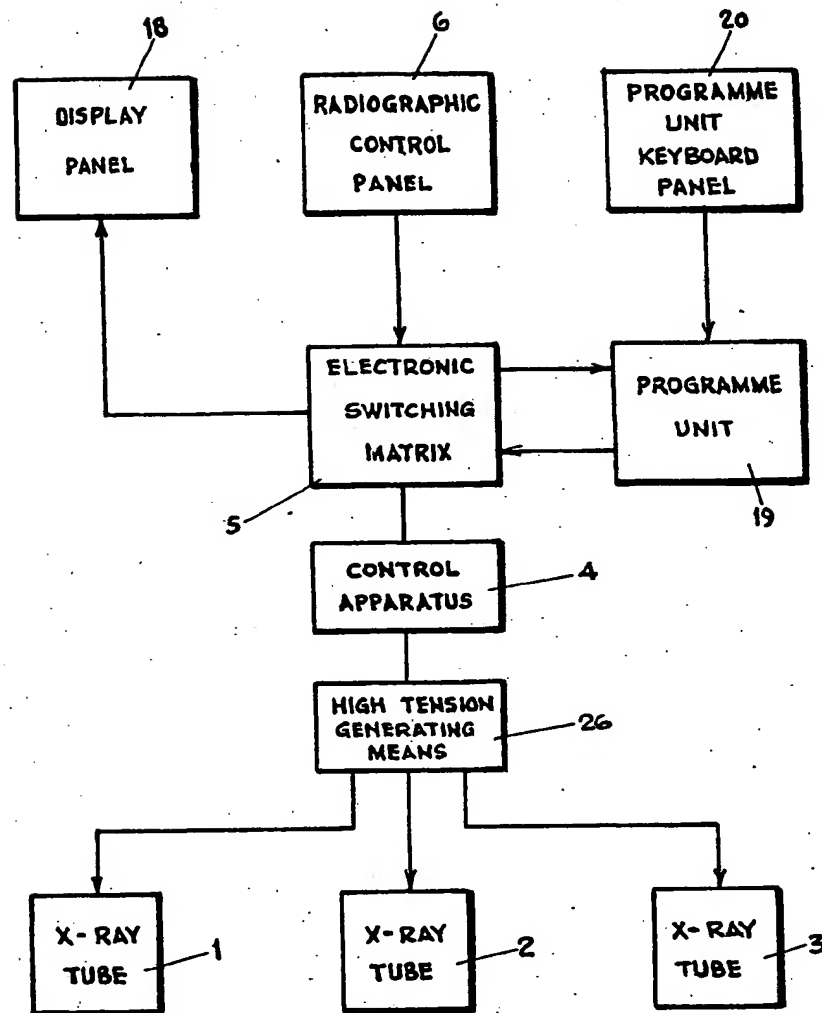
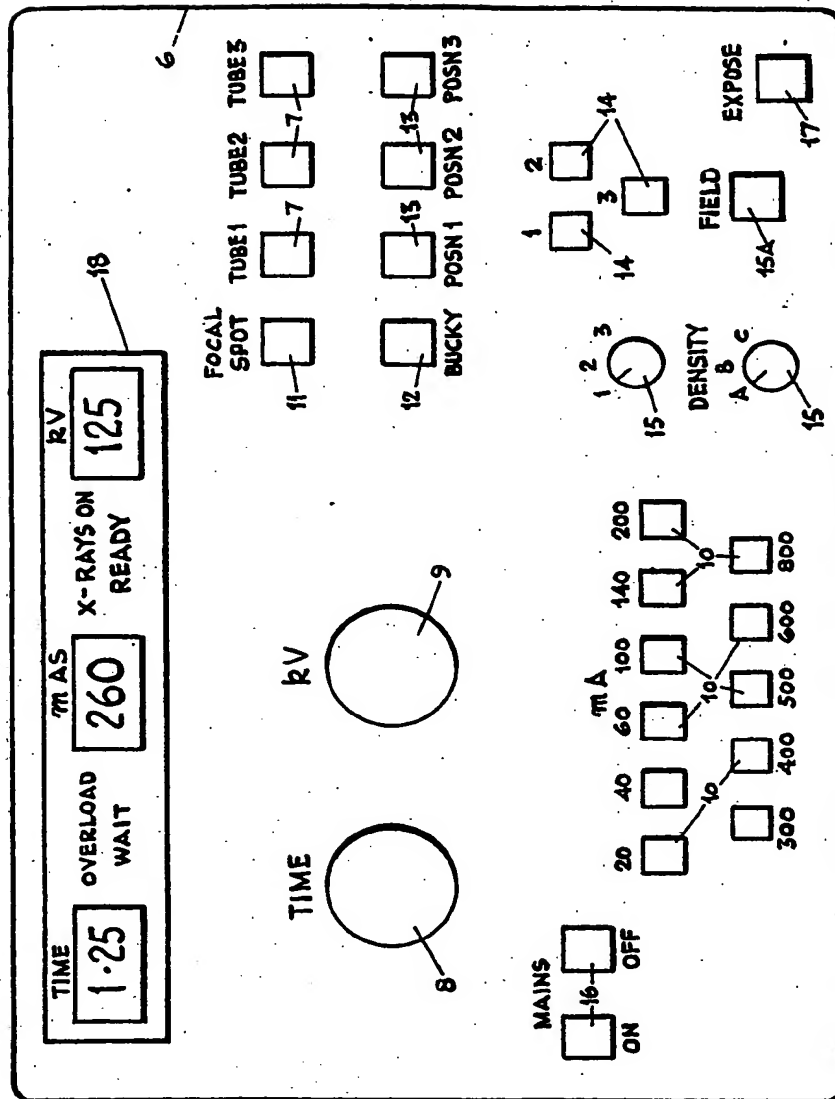


FIG.1.



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COMPLETE SPECIFICATION

3 SHEETS

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the Original on a reduced scale  
Sheet 3

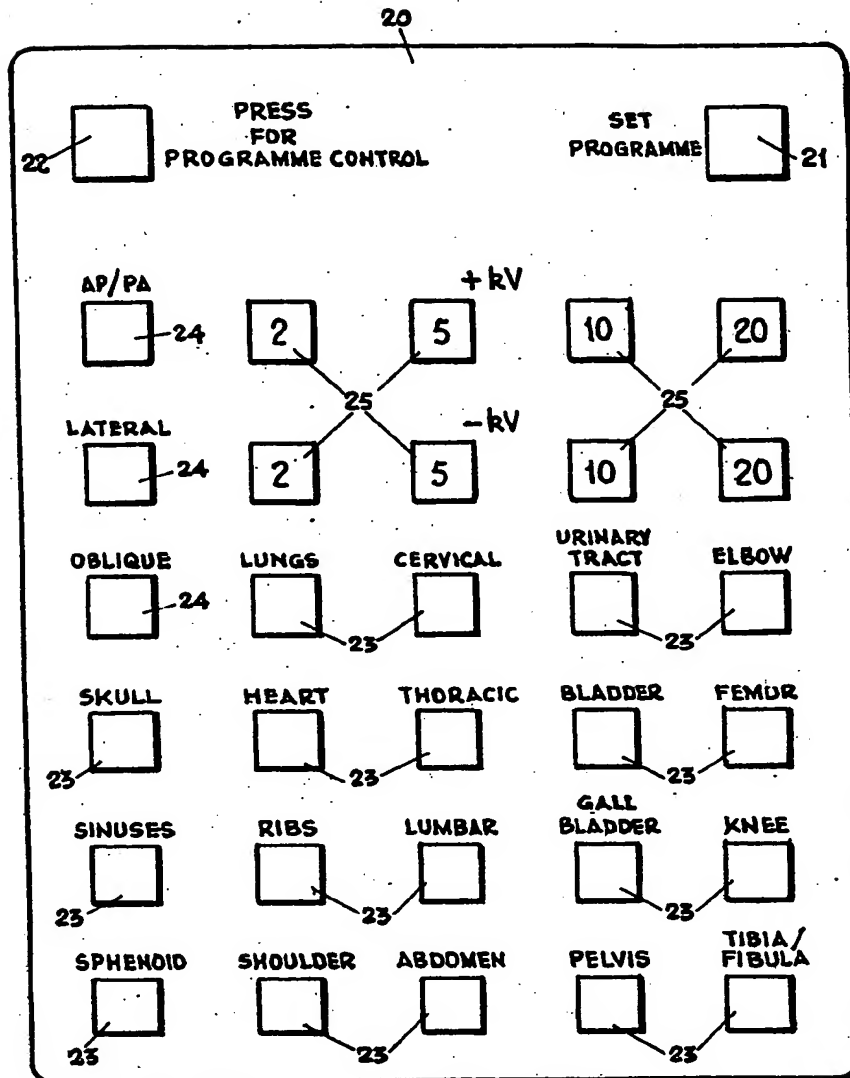


FIG.3.